

## Injury of a Northern Watersnake (*Nerodia sipedon sipedon*) in a Mountain Stream During Severe Flooding

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Flooding in mountain streams is a common event. The force of water moving rapidly through stream courses can cause substantial movement of rocks and soil and, as a result of severe rainstorms, the complete alteration of the physical structure of the channel. The flora and fauna inhabiting montane streams are also affected. Populations of aquatic invertebrates and fish experience downstream drift, varying levels of mortality, and local extinctions (Anderson & Lehmkuhl, 1968; Hoopes, 1974, 1975; Ross & Baker, 1983; Matthews, 1986; Tarter, 1990). Species occupying montane streams have probably adapted to periodic flood events in a variety of ways, including, for instance, finding shelter or being able to quickly repopulate decimated areas. Little is known of the effects of flooding on amphibians and reptiles in stream ecosystems, and nothing has been published on this subject on reptiles in Virginia (Mitchell, 1994).

On 27-28 June 1995, severe flooding occurred in the Blue Ridge Mountains of Virginia resulting in major structural changes in several mountain streams and rivers and substantial damage to fisheries resources and roads, farms, and homes downstream (Anonymous, 1995; Brandt, 1996). The Staunton and Moormans rivers on the eastern slope of the Blue Ridge Mountains were severely impacted, as were streams, such as Paine Run, on the western slope. As much as 80 cm of rain fell on the Rapidan River at Ruckersville in Madison County (Anonymous, 1995). Many tons of rocks were displaced and rearranged throughout the impacted channels of

these streams, and canopy trees were completely removed in many areas (JCM and CTWG, personal observations). Before the flood, Paine Run was characterized by an abundance of loose, small rocks, bank edge with no associated rock cover, scattered large boulders, and patches of rubble and gravel (Mitchell, 1996). After the flood, the stream contained all of these habitats but the number of rocks 0.1-1.0 m in size increased substantially throughout channel. Watermarks on trees and adjacent slopes indicated that the flood level in Paine Run was approximately 2-3 m above normal non-flood levels.

On 5 July 1995, we found an adult, female northern watersnake (*Nerodia sipedon sipedon*) in Paine Run, Shenandoah National Park, 8.2 km SSE Grottoes, Augusta County, Virginia that appeared to be lethargic and disoriented. The snake was lying on the northern bank 30 cm from the water's edge and did not try to escape. She measured 792 mm snout-vent length, 108 mm tail length (with tail tip missing), and weighed 225 g. Her body temperature was 24.0° C, ambient temperature was 25.0° C, and water and soil temperature were 16.0° C, indicating that she had been basking. Because she did not exhibit the expected rapid escape behavior and the fact that her body appeared to have been "beaten up" (wrinkled skin, roughened scales, weak and limp body, blind in the left eye), her behavior and condition suggested to us that she may have been injured in the recent flood. We collected the specimen for laboratory evaluation; it will be donated to the Shenandoah National

Park vertebrate collection.

Close examination of X-radiographs of this specimen revealed that two ribs on the right side attached to vertebrae 29 and 30 (counting from the posterior margin of the skull) located near the heart had been fractured. All other ribs and the skull were intact. There were no puncture wounds in the vicinity of the fractures. Internal inspection of internal organs revealed no obvious trauma. Radiographs and necropsy also revealed that she was not gravid nor had prey in her stomach.

Causes of the abnormal behavior, roughened appearance, and fractured ribs of this snake cannot be ascertained with certainty. The fact that we also found an intact, dead, adult northern spring salamander (*Gyrinophilus porphyriticus porphyriticus*) under an overhanging bank and a dead crayfish in the same area supports our hypothesis that this snake was injured by shifting rocks during the flood. On the other hand, we also found several uninjured salamanders (*Eurycea cirrigera*, *Desmognathus monticola*, *G. porphyriticus*) and a juvenile *Nerodia sipedon* (290 mm SVL). The female *N. sipedon* could have simply been an old adult in this population and may have been stressed in several ways, e.g., recent escape from a predator, hunger, or the flood. The lack of puncture wounds or other evidence of an encounter with a predator, however, supports our interpretation that the injury was caused by the flood.

Mortality and injuries of snakes inhabiting mountain streams during severe flooding are undoubtedly more widespread than we have been able to ascertain. However, the presence of uninjured snakes and salamanders before and after such events suggests these animals possess behaviors or have escape routes to avoid being killed or injured by periodic floods. Other observations of amphibians and reptiles following severe flooding should be reported and collections and evaluations of dead and injured specimens after such natural events should be made whenever possible.

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